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ABSTRACT

A study investigated how young children use the word processor as a tool in their development as writers. Forty children, ages 4 through 7, from a university laboratory school in a small midwestern community, participated in the study. Videotapings and audiotapings during writing events served as the primary means of data collection. These were supported with children's written language productions from the computer printer and field notes from informal teacher interviews. Analysis of the children's writing behaviors with the word processor was based on Piaget's cognitive development theory applied to written language learning. Features of children's written language were classified according to Marie Clay's beginning writing concepts and principles. Children's writing development correlated with findings from studies of young children learning to write with traditional instruments. Features of their writing paralleled many of Clay's concepts and principles of early writing development. Findings supported Clay's research and imply that young children can use the word processor in a creative writing program to promote their developing writing abilities in many ways and in different ways at different stages of their development. (One figure and four tables of data are included, and 100 references are attached.) (Author/SR)

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THE WORD PROCESSOR AS A TOOL FOR DEVELOPING YOUNG WRITERS

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ABSTRACT

The purpose of this study was to explore children's use of the word processor as a writing tool. The study attempted to answer the following question: In what ways do young children use the word processor as a tool in their development as writers? Videotapings and audiotapings during writing events served as the primary means of data collection. These were supported with children's written language productions from the computer printer and field notes from informal teacher interviews. Analysis of the children's writing behaviors with the word processor was based on Piaget's cognitive development theory applied to written language learning. Features of children's written language were classified according to Marie Clay's beginning writing concepts and principles. Children's writing development correlated with findings from studies of young children learning to write with traditional instruments. Features of their writing paralleled many of Clay's concepts and principles of early writing development. Findings supported Clay's research and led to important pedagogical implications for early childhood teachers and teacher educators.

THE WORD PROCESSOR AS A TOOL FOR DEVELOPING YOUNG WRITERS

The dramatic emergence of the microcomputer in early childhood classrooms has prompted educators to question the appropriateness of using this technology with young children. A body of literature produced during the 1980s reveals what we have learned.

Children as young as three and four years are able to use a computer after a brief period of instruction (Anselmo & Zinck, 1987; Borgh & Dickson, 1986; Buckleitner & Hofmann, 1987; Rosegrant, 1984; Rosengren, 1985; Shade & Watson, 1987; Tan 1985). Young children choosing to use a computer are lively, playful, enthusiastic, and sociable in their computer activities (Ball, 1986; Borgh & Dickson, 1986; Brady and Hill, 1984; Campbell, 1987; Clements & Nastasi, 1988; Essa, 1987; Genishi, McCollum, & Strand, 1985; Hyson & Morris, 1986; Johnson, 1985; Nelson, Killian & Byrd, 1988; Rosengren, Gross & Abrams, 1985; Rubens, Poole & Hoot, 1984; Shade, Nida, Lipinski & Watson, 1986; Zaijka, 1983).

They prefer software programs that involve cognitive challenge, critical thinking, problem solving, and creativity (Ainsa, 1989; Anselmo & Zinck, 1987; Chaille' & Littman, 1985; Clements, 1983, 1985a, 1985b; Genishi, 1988; Grover, 1986;

Hofmann, 1986; Haughland & Shade, 1988, 1990; Hofmann & Buckleitner, 1988; Lawler, 1982; McLanahan, 1984; O'Brien, 1987; Papert, 1980; Shade, Nida, Lipinski, & Watson, 1986; Sherman, Divine, & Johnson, 1985; Siann & Macleod (1986); Silvern, 1988a; Tan, 1984; Tsantis, Wright & Thouvenelle, 1989; Wright & Samaras, 1986; Yawkey, 1986).

Some studies documenting young writers' experiences with word processing are reported. Children evidently benefit from the scaffolding or support provided (Clements, 1987; Rosegrant, 1986). Handwriting, an arduous task for beginning writers, is supplanted by keyboarding. Erasing and editing are easy, reducing the penalty for making errors. This enables children to write more, make more revisions, and show pride in their written productions (Phenix & Hannan, 1984; Neufeld, (1989). Third and fourth graders working in pairs with a computer in the "writing center" reported great advantages over pencil and paper, "You can write faster and better. You also don't need to erase." (Levin, Boruta & Vasconcellos, 1983) and, "When you push the space bar you get exactly the right amount of space!" (Levin & Boruta, 1983).

A word processor interfaced with synthesized speech echoes letters, words, sentences, and pages of text as children type at the keyboard. This talking version provides spoken feedback which reportedly leads to increased editing (Borgh and Dickson, 1986; Rosegrant, 1985, 1988).

Children experiment with written language and learn to manipulate text (Brisk, 1985; Cochran-Smith, Kahn, Paris,

1988; Hofmann, 1986; Piazza & Riggs, 1984; Piazza & Tomlinson, 1986). This use of the computer "allows children to play with written words just as freely as they play with oral language. Instead of chiseling words out of granite, a painstaking, error-prone, irreversible process, word processors make writing more like sculpture with clay." (Clements, 1985a, p. 195).

Children have also been observed cooperating, collaborating, and helping each other during writing time (Dickinson, 1986; Brisk, 1985). This included considerable talk conducive to planning, self-monitoring, and responding to what was being written.

Such use of the computer has been observed in programs where the focus is, in Halliday's (1973, 1978) terms, on "learning how to mean" in written language. The emphasis in these process- oriented writing programs is on communication that is meaningful and functional as children engage in the process of writing.

The Writing Process

Research demonstrates that the process of writing text (composing) follows certain steps: rehearsal, draft writing, revision, and editing (Calkins, 1986; Graves, 1975, 1979, 1982, 1983; Harste, Woodward, & Burke, 1984; Murry, 1982, 1984; Temple, Nathan, & Burris, 1988). Rehearsal refers to the preparation for writing --- of getting ideas out in the open. For young children it takes the form of talking, drawing, or role playing. Draft writing refers to putting thoughts on paper with a purpose and an

audience in mind. For the three-year-old, the process consists of picking up a pencil or other writing instrument, marking on a paper, and reading or telling the intended meaning of the mark. At the age of six, the process is broader and more complex. As children write they may seek a response from an adult or peer. This constitutes a conference which may lead to changes in the message, a revision. The final step is to edit, to clean up a revised draft. However, children should edit only for those skills that are appropriate for their ability and stage of development as writers.

Emergent Writing in Young Children

Research indicates that children's written language learning is developmental and begins before schooling (Bissex, 1980; Chomsky, 1970, 1979; Clay, 1975, 1982; Ferreiro, 1978, Ferreiro & Teberosky, 1982; Harste, Burke & Woodward, 1984; Read, 1975; Teale & Sulzby, 1986). Their written expressions tell us about their developing concepts of written language. This enables us to follow children's progress as they move from cursive-like marks to invented symbols, to random letters and numerals, to organized letter strings, to invented spellings, and finally to standard writing. They become aware of the functions of writing (Schrader, 1989), of audience (Calkins, 1986), of sound-letter correspondence (Read, 1975) of wordness (Morris, 1980), and of some of the conventions of writing (Calkins, 1986).

This is a cognitive theory of development applied to written language learning. Ferreiro and Teberosky (1982) interpreted

Piaget's theory as a general one "which lets us understand any process of acquiring knowledge." (p. 14). Consequently, they used a clinical interview method within the framework of Piagetian (1962, 1977) theory to explore the processes children use to learn about written language. They reported that as children strive to make sense of written language they function as active learners who sort, classify, formulate hypotheses, test, and revise their knowledge of what writing is. They explore other hypotheses before discovering that the writing surrounding them is alphabetic.

Emergent Writing and the Word Processor

The role of the word processor in children's developing writing is one of many issues and concerns needing careful investigation (Brady & Hill, 1984, 1986; Clements, 1985c; DeGroff, 1990; Green, 1984; Goodwin, Goodwin & Garel, 1986; Lee & Houston, 1986; Newman, 1984; Sheingold, 1986; Swick, 1989a, 1989b; Watson, Nida & Shade, 1986; Woodill, 1987). Empirical data are needed as a basis for making decisions concerning instructional settings, appropriate software, curricular experiences, and methods of instruction. Hence, the purpose of the present study was to explore children's use of the word processor as a writing tool. The study attempted to answer the following question: In what ways do young children use the word processor as a tool in their development as writers?

METHOD

Participants

Forty children voluntarily participated in the study: 8 four-year-olds, 9 five-year-olds, 10 six-year-olds, and 13 seven-year-olds. The children were enrolled in preschool, kindergarten, first, and second grade in a university laboratory school in a small midwestern community. All of them were from middle class families. Their native language was English. One child was from a minority racial and ethic group.

Discussions with participating children established that all had had some experience with typewriters and/or computers at home or at a parent's place of work. None had used a word processing program.

Procedures

The Computer in the Classroom

Learning centers were in place in each classroom prior to the study. One or two computers were present as one of many learning centers available to the children during center time on a free choice basis. Children chose where they wanted to work. Rules and procedures provided guidelines and set clear expectations for behavior and interaction in the learning centers; for example, a working child could be observed but should not be disturbed and sharing work-in-progress was encouraged but by consent of the child.

Word processing programs and printers had not been used

in the classrooms. These were introduced by the researcher. A computer cart was adjusted to child level and equipped with an Apple IIe computer and an Epson printer. The researcher introduced Magic Slate (in the 20-column mode), a word processing program from Sunburst Communications. This program provides picture choices for commands and enlarged primary style type on the monitor screen and for printouts.

Based on discussions by Hoot (1986), Hoot & Hoag (1987), Silvern (1988b), and Kahn and Freyd (1990a, 1990b), it was judged not necessary for children to learn to type prior to using the word processor. Children became familiar with the keyboard as they wrote. Emphasis was placed on making meaning during composing.

During the second phase of the study, the computer was moved to a nearby room. This allow the researcher to continue to observe specific children for an extended period of time (see Tables 1 and 2).

The Role of the Researcher

The researcher's role was that of participant observer. She was present during each session and available to the children for aid and support. She acted as a facilitator who introduced the children to the word processing program and then participated spontaneously to encourage the children's autonomous exploration, experimentation, problem solving, and playful use of the computer.

Theoretical support for this guided discovery style of

learning and teaching is provided by Vygotsky's (1978, pp. 86-91) "zone of proximal development". Adults can help children go beyond their present developmental level by responding to them and extending what they are trying to do. Therefore, the purpose of the researcher posing questions, making comments, and offering suggestions was to enable each child to progress as a writer. Emphasis was placed on the child maintaining control of his or her learning. The investigator's part was to listen and observe to determine the child's intentions, then follow the child's lead, accepting approximations and encouraging further exploration.

The Writing Activities

The process approach was used by the researcher to engage children in writing activities. Children were invited to first talk or draw a picture using crayons or markers about a topic of their choice. They were then encouraged to write using the word processor. The researcher interacted with the children during writing events and invited them to read their writing and/or tell about it. Picture drawn before or after writing were assembled with text and a construction paper cover and stapled to make booklets. These were shared with classmates, teacher, and family. Prior to beginning the research, the researcher provided parents with information about beginning writing to enable them to understand, accept, and value random letter strings and invented spelling as developmental steps toward standard writing.

Data Collection Procedures

The naturalistic inquiry paradigm (Lincoln & Guba, 1985) was employed for the study for several reasons. Literacy learning is a holistic, social, problem-solving process. Naturalistic inquiry permitted observation of the writing process as it occurred in the classrooms, provided rich descriptive data of the children's interaction with the computer and the researcher, and enabled the researcher to observe links between each child's computer use and his or her developing writing.

Videotaped writing events enabled the researcher to look closely at the way children go about their writing --- to capture each child's learning-to-write strategies. Two days of researcher and videotaping equipment visitation prior to data collection enabled the children to ask questions and accept these changes in their classrooms.

The children were also audiotaped. The researcher used a small microphone and audiotape recorder to capture children's oral language as they interacted with the computer and the researcher. This also served as a backup system in case of technical failures.

The videotapings and audiotapings were supported with researcher recorded field notes. Informal interviews with teachers produced information about the children and their writing. These field notes further enabled the researcher to verify each child's progress in learning to write.

The children's written language productions from the

computer printer were collected to further document the youngsters' developing writing abilities. Researcher-child discussions about these writings were captured by the recordings.

Thus, triangulated data collection was accomplished by (1) videotapes and audiotapes of the children's behaviors and language during writing events, (2) children's written language productions and discussions about these writings, and (3) the researcher's field notes. This procedure enabled the researcher to study the actual process of each child's writing as he or she developed, to confirm the data, to obtain a check on the dependability of the data collected, and to give credibility to interpretations of the data (Evertson & Green, 1986; Genishi, 1982; Lincoln & Guba, 1985).

Data were collected in two phases (see Tables 1 and 2). Phase I involved collecting data on 8-10 days during a three week period for thirty minutes per day in each of the four classrooms. A focal child in each classroom was identified and given priority for repeated use of the word processor. All four focal children were judged by their classroom teachers to be average in school achievement. Phase II involved observing the focal children from preschool, kindergarten, and grade one on 10-13 days during 4-6 additional months in a nearby room. On the final day these three focal child were interviewed briefly: Which would you rather write with, a pencil or a computer? Why?

Insert Tables 1 and 2 about here.

Analysis

The children's use of the computer, writing and reading behaviors, corresponding actions, and oral language were transcribed from the videotapes and audiotapes. These typescripts were then compared with the children's written productions and the researcher's field notes. The children's written language productions from the computer were studied for identifiable writing patterns and learning-to-write strategies.

Each child's writings and writing strategies were analyzed from a developmental perspective, as moving from initial marks on paper toward conventional writing. Therefore, specific aspects of each child's writings were coded and categorized according to Clay's (1975) beginning writing concepts and principles.

CODING CATEGORIES

Clay's Concepts and Principles

Recurring Principle: The same symbol is repeated many times in a string.

Generating Principle: There is variety in the arrangement of symbols. They are repeated in different combinations.

Sign Concept: The symbols stands for something else. The writing says something.

Flexibility Principle: Letters are made up of a combination of features. Letters can be varied to produce new letters or to invent letters that do not exist.

Linear and Directional Principles: Letter identity depends upon letter orientation. Letters are set in a pattern from left to right and top to bottom.

Page Arrangement: Thought is given to how the words on the page are to be arranged.

Concept of a Word: A string of letters represents a word. It may or may not be bounded by a space or a mark.

Spaces Between Words: Spaces or marks are used to indicate word boundaries.

Inventory Principle: All known words that can be produced are written. They do not convey a message.

Punctuation or Signs: Punctuation marks and/or signs are used as part of a message.

RESULTS

The children demonstrated their developing knowledge of written language by writing and reading and discussing their writings with the researcher. They also demonstrated how they could use the word processor in conjunction with their developing writing strategies as they engaged in the writing process. This enabled the researcher to identify and classify their emergent writing behaviors as they progressed (Tables 3 and 4).

Insert Tables 3 and 4 about here.

In addition to these data tabulations, examples from writing events were selected for illustration.

Clay's Concepts and Principles

Recurring Principle

The recurring principle was evident in two ways. Either children intentionally typed the same letter many times or unintentionally pressed a key too hard and produced multiple, identical letters. As children progressed in their writing development, recurring symbols of more than two or three became less acceptable to them and were deleted. For example, when Chris (preschool) wrote his name he pressed the letter "s" too hard and produced "Chriss." He said, "I meant to get one. I meant for this to be a S, but I needed one not two." On another day Chris used random letters to represent his message, pressed the key too hard producing a string of letter "R"s and said, "Whoa!" He deleted all but one saying, "There, I only need one R."

Generating Principle

Children employed the generating principle when they varied symbol arrangements. Furthermore, as children gained writing experience they exhibited qualitative changes in the text they generated, indicating their changing ideas of how written language works. Their progress was similar to that described in studies by Ferreiro (1978) and Ferreiro and Teberosky (1982, pp. 180-209). Children hypothesized relations between written and oral language and progressed from writing without reference to sound, to syllabic writing based on sound, to alphabetic writing based on letter-sound correspondence.

Symbols for running language: A string of random letters represents a string of words as when oral language is spoken. It all runs together. When rereading text children try for a print-to-voice match.

Example: Amy (kindergarten) used a variety of letters in different combinations to write about her drawing. She reread her text many times, running her finger from left to right on the screen. Each time she worked to match her written language to her oral language.

abenspnlkhnmgrktrscl "The bunny is hopping in the grass.
stbtcbtfecufvchutyrv And the sun is shining.
hybnosnhmtrfmfethnhq And the bunnies
ajnghgykiyvdscujgbuh are playing."

Symbols for words: A string of random letters represents one word. The words may or may not be separated by spaces or marks.

Example: Chris (preschool) used a variety of letters in different combinations to represent words. (See Figure 1 for actual spacing.)

zasqwe	rdf	reds	red	ghf	yh	fb
My	cat	sleeps	on	top	of	me.

Symbols for syllables: This is syllabic writing. Letters are used as syllable counters. Words are represented at the syllable level.

Example: Chris (preschool) talked and wrote simultaneously, representing each syllable with a letter. (See Figure 1 for actual spacing.)

H G F C V S
My lizard eats crickets.

Symbols for sounds: This is alphabetic writing. Each letter represents a sound. There are no "silent" letters or extra letters.

Example: Matt (grade 1) probed orally for sound-symbol relationships, representing each distinguishable sound with a letter.

IHAVACATADADOGMI
I have a cat and a dog. My

CATBITSMITOZ
cat bites my toes.

Symbols for numbers: Numerals represent number words or numbers.

Example: Chris (preschool) used numerals to represent number words. (See Figure 1 for actual spacing.)

1RED 1SDW 1ERRD
one cat, one dog, one lizard

Insert Figure 1 about here.

Sign Concept

Children demonstrated their emerging concept of sign when reading their writing either spontaneously during or after writing or by invitation. Josh (preschool) wrote about his drawing. He told about part of his writing while comparing it with his picture. He then shifted to using a reading voice, ran his finger from left to right, top to bottom, and read his writing. He attempted to match his oral language to his written language.

R: Here's the story and here's the picture. What does that say?
(Looks at printout with child.)

C: This is all the snow coming down.
(Points to line 1. WWERDOJUOOOOOOOOOE)

And this is the little bugs.
(Points to line 2. GGXZEEEDFFGGGYYYYTRS)

And some of this stuff is..... (Looks at printout.)

R: What does that say? (Points to line 3.)

C: That says, "When is it going to snow?"
(Points to Line 3. DDWWETTYDSSSSDDDDSSD)
And it says, "It is snowing today." (Points to Line 4, matching voice to print. WWGGGBBCCXZASNHBVVCX)

R: Alright.

C: And it says on the bottom.... It's going to be a different part. "Some day it is going to be Trick or Treating day.
(Points to Line 5. VBBBGFFFFDDSS33RE443)
La, la, la, la, la. [a song].
(Points to Line 6. WXAXGGDSXZBHVVRREAAW)

R: Well that's nice. I like that. Good job.

Flexibility Principle

Children were not observed working with the flexibility principle as the computer determines letter formation.

Linear and Directional Principles

Word processors determine linearality and directionality so children were not observed manipulating these features. They were, however, seen or heard responding to cursor movement as it progressed from left to right and automatically returned to the left side of the screen. For example, Chris (preschool) noticed how the cursor moved from the end of his first line of print to the left side of the screen saying, "Oh, oh. Now we are going this way." He traced the cursor's path with his finger on the screen. Letter orientation was also controlled by the computer.

Page Arrangement

Children worked with page arrangement, at first as they would with pencil and paper. They compared the amount of space left on a line with what they wanted to write next. They soon learned, however, that the computer offers assistance here. If their word would not fit on a line, the word processing program automatically moved text for them. Children responded to this help with surprise and delight. At one point Cody (grade 1) said, "Thank you." to the computer.

Concept of a Word

Children's developing concept of a word and techniques for marking word boundaries were noted as they read or talked about their writing. They pointed to the screen and/or their printout to show how their writing represented their messages and words. Chris (preschool) talked and wrote about his pets, using the syllabic system to represent most of his message. However, when asked to read his writing at one point, he indicated that a letter string represented a word. See Figure 1 and the following writing event segment.

C: (Simultaneously writes and whispers. Each letter represents a syllable. My cat sleeps on top (zasqw)
R: of (no letter for "of")
C: me. (e)
R: Is that what that says, "My cat sleeps on top of me."?
C: (Points to first letter and begins to read.) My... (Runs finger left to right in letter string and reads.) My. It says, "My."
R: Oh, then we have to write cat.
C: (Spaces once.) That's one word, My. (Points to letter string zasqwe.)
R: This is one word. (Points as child did.) Ok, now write cat.
C: (Writes rdf.) cat

R & C: My cat (Reread text.)
R: Now write sleeps.
C: (Writes reds.) sleeps
R: on
C: (Spaces once and writes red for "on".) on
R: Ok, top.
C: top (Writes ghf for "top".)
R & C: of
C: (Writes yh for "of".) me. (Writes fb for "me".)
Ok, now I'm ready to print it.

Spaces Between Words

Children quickly and easily learned to use the space bar. Chris (preschool) initiated this on the fourth day of using the computer and in conjunction with developing his concept of a word.

C: Now how do you make a little space between?
R: I'll show you. Watch this. Watch what happens when I push this [space bar]. It makes the cursor move over and then you have a space.
C: (Chuckles.)
R: Now type something and see what happens.
C: I need it [cursor] back right there. (Points to screen indicating a smaller space.)
R: Ok, then push delete and it [cursor] will back up.
C: This? (Touches the return key.)
R: No, this. (Points to delete key.) It's like taking away a space. Now you can put something right here if you want to. (Points to screen.)
C: (Types random letter string.) That's because this is another word. (Points to letter string.)
R: Oh, I see. You have to have a space when you make another word.

Cody (grade one) and other children frequently forgot spaces between words. However, after rereading their texts they would delete a word, insert a space, and then rewrite the word. Each one expressed appreciation for the ability to make this correction without erasing pencil from paper.

Inventory Principle

The inventory principle was rarely observed. This is probably due to the meaning focus of the writing activities. For the most part children's writings conveyed messages. Amy (grade 1) began by writing only words she knew how to spell but ended by approximating spellings and writing a sentence, "I had a cat."

mom dad amy sarah
book my by i hid a
cta

I had a
cat.

Punctuation or Signs

Punctuation marks and signs appeared in two ways. The computer keyboard presented these to children when they randomly or accidently hit such keys or when they noticed these as typing options. With experience, accidental punctuation or signs frequently led to intentional use of marks as part of their text. For example, Chris (preschool) deleted an accidental semicolon saying, I didn't need that." Six days later, however, he used semicolons to indicate word boundaries. He wrote dfggf;;JJiuigb;;nhy, pointed to each letter string on the screen and said, "This is one word. This is one word. This is one word."

Grade one and grade two children approximated conventional uses of periods, question marks, and exclamation marks in their writings. An example is Eric's (grade 2) message to his mother.

DERA MOM HOW WAS YOUR DAY MY DAY WAS FIN AND I RED THE MOUSE AND THEMOTORCYCLE ITS A NET BOOK!!	Dear Mom, How was your day? My day was fine and I read the mouse and the motorcycle. It's a neat book!

Final Day Interviews With Focal Children

Focal children from preschool, kindergarten, and grade one were asked about their preference for writing instruments. Chris (preschool) valued crayons and pencils because they allowed him to work with the flexibility principle. Amy (kindergarten) and Cody (grade 1), however, valued the computer as a writing instrument because it supplants manual letter formation and makes writing and changes in writing faster and easier.

Chris from Preschool

R: Which would you rather write with, markers, crayons, and pencils or the computer?
Chris: I want to write with the crayons and pencils and markers.
R: Why?
Chris: Because then you can make your own shape. Like, you can make another shape of "G".
R: I see. You can make your own shapes with pencils but not with the computer?
Chris: Un-huh (Yes).

Amy from Kindergarten

R: Which would you rather write with, a pencil or the computer?
Amy: Um, the computer.
R: Why would you rather use a computer?
Amy: Cause it writes better.
R: What does it do that's better?
Amy: It makes the words [letters] better.

Cody from Grade One

R: Which would you rather write with, a pencil or a computer?
Cody: Computer.
R: Why would you like the computer?
Cody: Because you don't have to erase.
R: What else?
Cody: It types better, it's faster.
R: Anything else?
Cody: And you can make big and small letters.
R: Yes.
Cody: And they're straight.

DISCUSSION AND IMPLICATIONS

These data demonstrate ways in which the word processor can be a powerful learning devise for facilitating natural writing development in young children. Children were observed in the actual process of using this tool to go about their business of constructing knowledge about our writing system.

Their development correlated with findings from studies of young children learning to write with traditional instruments. They progressed by working first with the whole [lines of writing representing sentences] to later with the parts [letters representing individual sounds]. As described in studies by Ferreiro (1978) and Ferreiro and Teberosky (1982), children made a series of shifts in their ideas about what writing is before they arrived at the alphabetic principle of letter-sound relationships. They passed through different stages of invented spelling as reported in studies by Chomsky (1979), Henderson and Beers (1980), and Read (1975). Their stages of spelling, when placed in developmental perspective, illustrated how their early spelling strategies gave way to later ones. Features of their

writing paralleled many of Clay's (1975) concepts and principles of early writing development. Thus, the study provides empirical support for Clay's research. This is particularly important as Clay analyzed only writing products. She had not actually observed children in the process of producing them (Clay, 1982, p. 226.)

The advantages of using the word processor as a tool for engaging in the process of writing were clear. Participating children were willing and eager to use this tool. On the first day in preschool the researcher sat at the computer, assuming it would be necessary to model word processing for the children. On the contrary, Alex said, "I think you better let me do that." and moved into the writer's chair. Amy (kindergarten) soon figured out that if she came early to school she could be the first one in the door and the first to use the word processor.

Support provided by this tool enabled children to focus on content and meaning. Putting thoughts into print became faster and easier. Consequently, children were less likely to lose the meaning or the grammatical structure they began with. Revising and editing were less costly in time and effort. This was a definite advantage to children who were working with spacing between words. Focusing on content frequently caused them to forget to space. They were delighted with being able to quickly and easily insert the needed space rather than having to erase (a messy business with paper and pencil) or recopy their entire text (a tedious business with paper and pencil). As children gained experience they exercised their high degree of control by moving

the cursor to locate and change text.

Publishing was effortless and attractive, and multiple copies were produced. One was assembled with illustrations to make a booklet. The sense of authorship was evident as children shared these with others. The second copy provided an excellent source for documenting a child's gradual progress over time. Writing folders containing printouts of children's work arranged chronologically allowed comparisons of earlier and later works.

Prior to the study it was assumed that writing with the word processor was an advantage to youngsters who were struggling with letter formation, allowing them to focus on content. Indeed, children generally expressed an appreciation for the speed and accuracy. Chris (preschool), however, raised an issue worth careful consideration. Changing the shapes of the letters was important to him. It is likely that manipulating symbol shapes during the earliest stages of writing enables younger children to construct knowledge in this area. If so, it becomes critical that traditional marking instruments continue to be available.

The study led to important pedagogical implications. Young children can use the word processor in a creative writing program to promote their developing writing abilities in many way and in different ways at different stages of their development. Therefore, this technology should be available to young children as one part of a well-equipped writing classroom. A variety of writing instruments should be there. Writing experiences should consist of children selecting their own topics, interacting with others, and writing whole and meaningful text. Their intrinsic

motivation to write with this tool should be the guiding factor in determining the frequency and extent of its use by individuals over time. Children need control of time and what to write, and they need to set their own paces. Such use of word processing is not only compatible with process-oriented curriculum and instruction, it offers unique advantages to young children as they engage in meaningful writing.

Teaching strategies that encourage autonomous exploration, problem solving, and play with written language should be employed. Teachers can cultivate literacy development as children write with word processors by watching closely the way children go about their writing, interacting spontaneously, and accepting with respect the written products they offer. These strategies enable teachers to document how young children grow as writers and respond in ways that extend that growth.

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able 1. Phase I Data Collection Schedule, Participants, and Number of Days Child Used Word Processor

eptember		October		November		December	
reschool	N	Kdg.	N	Grade One	N	Grade Two	N
ris	9	Amy	7	Cody	9	Erica	4
lex	5	Lindsay	7	Melissa	1	Eric	1
indsey	5	Tammie	4	Matt A	1	Nicholas	1
osh K	4	Anna	3	Amy	1	Timothy	1
oshua R	2	Toby	3	Matt H	1	David	1
tephen	1	JJ	3	Matt R	1	Jackie	1
oshua B	1	Jamie	2	Kristin	1	Nick B	1
atrick	1	Deborah	2	Jared	1	Kari	1
		Alena	1	Beth	1	Ivery	1
				Laura	1	Christian	1
						Michael	1
						Laura	1
						Jeremiah	1

ote: All children in grades 1 and 2 expressed a strong interest in iting with the word processor. Consequently, those classroom achers suggested to the children that they each use it once until l had a turn.

able 2. Phase II Data Collection Schedule, Participants, and Number of Days Child Used Word Processor.

tober		November		December		January		February		March		April	
cal Child	N	Focal Child	N	Focal Child	N	Focal Child	N	Focal Child	N	Focal Child	N	Focal Child	N
ris	2	Chris	2	None	0	Chris	3	Chris	3	Chris	1	Chris	2
						Amy	3	Amy	2	Amy	2	Amy	3
						Cody	3	Cody	2	Cody	3	Cody	4

Table 3. Features of Focal and Nonfocal Children's Writing with a Word Processor During Phase 1.

	PRESCHOOL		KINDERGARTEN		GRADE ONE		GRADE TWO	
	Focal Child	Nonfocal Children	Focal Child	Nonfocal Children	Focal Child	Nonfocal Children	Focal Child	Nonfocal Children
CONCEPTS & PRINCIPLES	Percent of days on which behavior occurred.							
Recurring principle	11	48	50	22				
Generating principle	100	100	100	91	100	100	100	100
Sign concept	88	57	100	87	100	100	100	100
Flexibility principle								
Linear/Directionality								
Page arrangement				4	88	22		42
Spaces between words	66		14	12	100	55	100	92
Concept of a word	66		14	24	100	100	100	100
Inventory principle						33		
Punctuation/Signs	44	54	71	64	22	11		67

Table 4. Features of Focal Children's Writing with a Word Processes During Phases I and II.

	Chris I	Chris II	Amy I	Amy II	Cody I	Cody II	Erica I
CONCEPTS & PRINCIPLES	Percent of days on which behavior occurred.						
Recurring principle	11		50				
Generating principle	100	100	100	80	100	100	100
Sign concept	88	100	100	100	100	100	100
Flexibility principle							
Linear/Directionality							
Page arrangement		30		30	88	83	100
Spaces between words	66	69	14	30	100	100	100
Concept of a word	66	77	14	70	100	100	100
Inventory principle		46					
Punctuation/Signs	44	38	71		22	25	

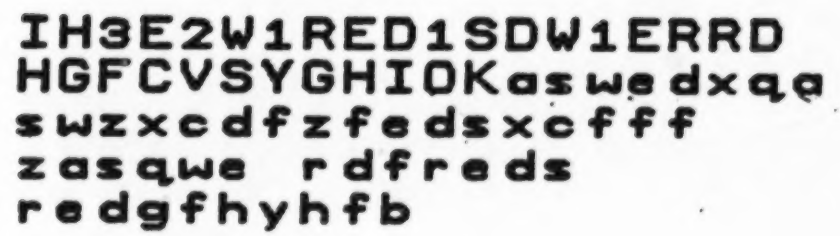

Figure 1. Chris (preschool)

I H 3 E2W 1 RED 1 SDW 1 ERRD
I have three pets, one dog, one cat, and one lizard.

H G F C V S Y G H I O K
My lizard eats crickets. My dog's name is Stella.

a s w e d x q a s w z x (1)
My cat's name is Blanche. My lizard sleeps on the top

c d f z f e d s x c fff (3)
of the cage. (2) My dog sleeps on the toy box.

z a s q w e (4) zasqwe rdf reds red ghf
And my cat sleeps on me. My cat sleeps on top

yh fb
of me.

1. The researcher spoke the word "top" so Chris did not represent it with a symbol.

2. Chris accidently spaced once and said he needed it there. However, he promptly went back and inserted a "z".

3. The multiple "f" was due to pressing the key too long.

4. Chris changed his representation of the word "My" from one letter syllabic writing to a letter string. He then intentionally spaced once after his word "My" and used letter strings to represent subsequent words.